

INTERNET OF THINGS

Drowsiness Detection

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MOTIVATION

Drivers often feel very drowsy while continuously driving for long distances without taking breaks. Drowsiness is a major factor in increasing the chances for a vehicle to meet accidents . According to various studies, Number of accidents caused by drowsiness is much higher than the number of accidents caused by drunk driving. The number of accidents caused by drowsiness can be reduced by having a proper system that can detect drowsiness, alert the driver and prevent major injuries. It needs a proper system that will alert drivers to prevent major injuries.

OBJECTIVE

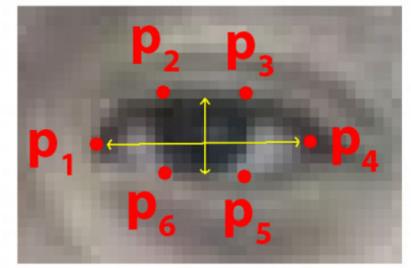
A computer vision system that can automatically detect driver drowsiness in a real-time video stream and then play an alarm if the driver appears to be drowsy. This system is used to detect drowsiness in any given person. In this system, we check how long a person's eyes have been closed. If the eyes have been closed for a long period i.e. beyond a certain threshold value, similarly it also detects the yawning of a person for drowsiness detection. The system starts an alarm when it detects the driver is drowsy and notifies drivers to take a rest along with a nearby rest services area.

SYSTEM INFORMATION

This drowsiness detection system is based on mainly two things: eye blinking and yawning(lips movement).

Blink detection: We use a media pipe library for facial landmark detection.

Each eye is represented by 6 (x, y)-coordinates, starting at the left corner of the eye (as if you were looking at the person), and then working clockwise around the eye.



Then, we calculate the blink ratio $(p_1-p_4)/(p_2-p_6)$. The distances measured are euclidean distances. If the eyes are almost closed i.e the vertical distance is very low, the ratio will be higher. If a person keeps his eyes closed for about 2 seconds, the number of blinks will increment by 1.

Yawn detection: We also need real-time facial landmarks to detect yawns. We are using a dlib library which is similar to media pipe. Each lip is represented by 6(x,y) coordinates. Now, to detect yawns we calculate lip_ratio similarly to blink ratio. Here, the ratio is directly proportional to the distance between the upper and lower lip. Yawn is detected when the person yawns for 2 seconds continuously and the counter is incremented.

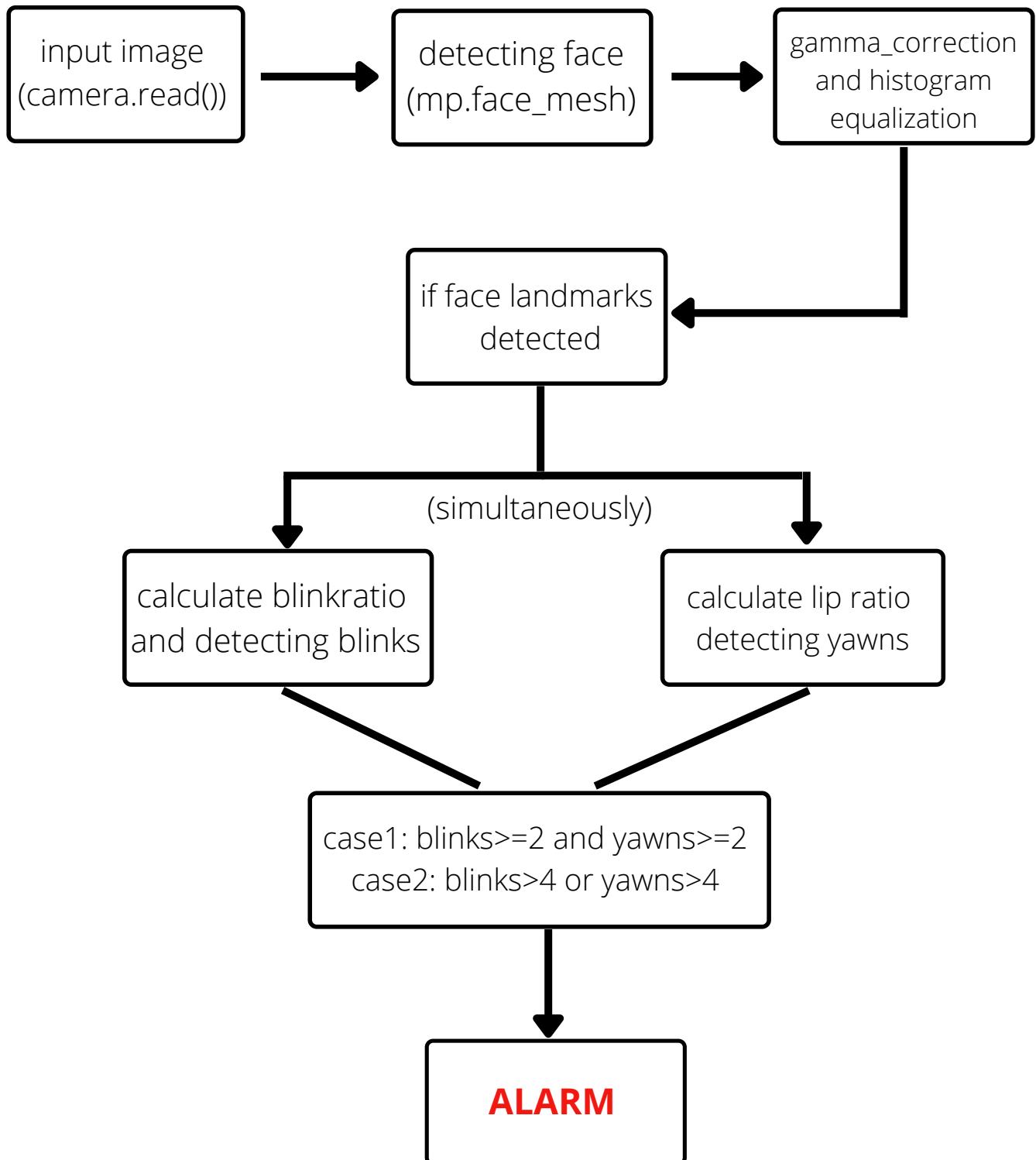
To overcome low-lighting conditions, gamma correction and histogram equalization are used. In gamma correction, image pixel intensities must be scaled from the range [0, 255] to [0, 1.0]. From there, we obtain our output gamma-corrected image by applying the following equation:

$$O = I ^ (1 / G). G \rightarrow \text{gamma value}$$

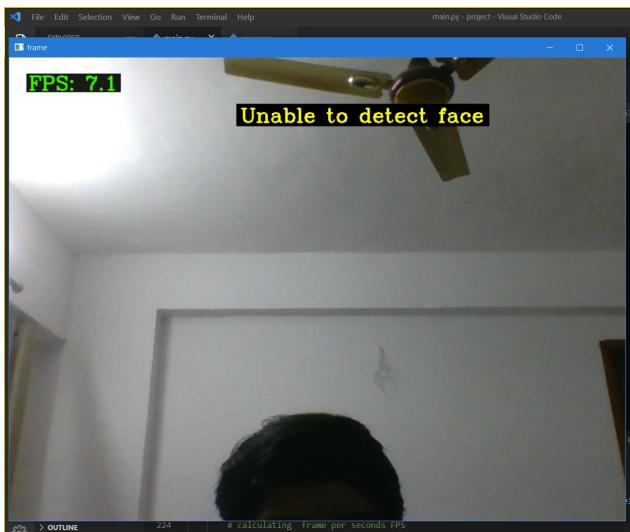
Gamma values < 1 will shift the image towards the darker end of the spectrum while gamma values > 1 will make the image appear lighter. A gamma value of G=1 will have no effect on the input image.

Histogram Equalization is a computer image processing technique used to improve contrast in images.

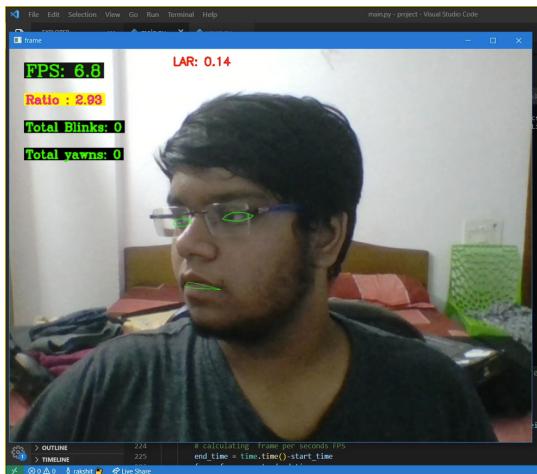
FLOW and APPROACH



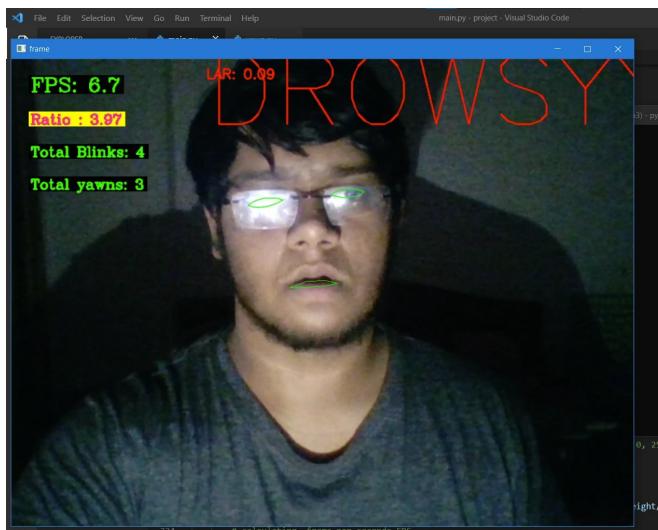
Results/outcome



The system first detects a face in a frame. Whenever the person's face is not visible, the system will wait till the face is visible and detectable.



The system still predicts the drowsiness if the head is moving sideways.



This also works in low-light conditions. As you can see, the person has yawned 3 times and blinked more than 3 times. The system will play an alarm if the person is drowsy.



The screen shows "YAWNING" when the users yawns for at least 2 seconds.

References

- “Iris.” Mediapipe, google.github.io/mediapipe/solutions/iris.html. Accessed 11 May 2022.
- “Detect Eyes, Nose, Lips, and Jaw with Dlib, OpenCV, and Python.” PylImageSearch, 10 Apr. 2017, pyimagesearch.com/2017/04/10/detect-eyes-nose-lips-jaw-dlib-opencv-python/.
- DRIVER FATIGUE AND ROAD ACCIDENTS A LITERATURE REVIEW and POSITION PAPER” . Royal Society for the Prevention of Accidents

GITHUB LINK: <https://github.com/rakshit-g/drowsiness-detection>